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RESEARCH ARTICLE

First record, new cultivated host and host plant preference of the invasive oak lace bug (*Corythucha arcuata* Say, 1832) (Heteroptera: Tingidae) in Transcarpathia (West Ukraine)

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Abstract

Oak lace bug (*Corythucha arcuata*) has continuously spread through Europe since its appearance in 2000, and it has become a dangerous pest of *Quercus* species in most countries. Despite of its high abundance in the surrounding countries it was found in West Ukraine only in 2020. During our investigation carried out in 2020 OLB was detected in all studied large forest patches of the Ukrainian part of the Carpathian Lowland. These were one of the newest distribution data from Ukraine after its appearance in the far coast of Black See near Yalta (South Ukraine). OLB most live on *Q. robur* and *Q. petraea* but in an orchard located near an infested forest patch we found infested sweet cherry (*P. avium*) trees, which is a new, formerly not mentioned cultivated host of the pest.

Keywords

hardwood forests, host plant preference, invasion, spread

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Introduction

The Nearctic Oak lace bug (OLB, *Corythucha arcuata* Say) is native in the United States of America and South Canada (Drake, Ruhoff, 1965). It was introduced into Europe in the late 1990's and after that it was recorded at two location parallelly. Bernardinelli (2000) found a population in North Italy Piedmiont and Lombardy in 2000, where its rapid distribution presuming earlier introduction (Bernardinelli, Zandigiacomo, 2000). In that time Mutun (2003) found other introduced population in Northwest Turkey in 2002. The first OLBs came to Hungary probably from the Turkish source area at the early 2010's soon after they appeared in Bulgaria in 2012 (Dobreva et al 2013). The firs Hungarian data was published by Csóka et al., (2013). OLB has two or three generations annually (Csóka, Hirka, 2017). Utilizing their rapid reproduction and spread, it was quickly spread in other parts of the Carpathian Basin. Populations were found in Croatia (2013: Hrašovec et al., 2013), Romania (2015: Don et al., 2016; Chireceanu et al., 2017), Slovenia (2016: Jurc, Jurc, 2017), Slovakia (2017: Csepelényi et al., 2017; Zubrik et al., 2019) and Austria (2019: Sallmannshofer et al., 2019) parallelly or shortly after their appearance in Hungary. In Ukraine, OLB was found in the Crimean Peninsula in 2016 (Shchurov et al. 2016; Neimorovets et al. 2017) and also in the Kershon Region in 2020 (Meshkova et al. 2020), but from other part of the country data were not provided till now.

Lace bugs generally do not fly well, so they mainly spread passively on anemo- and anthropochorous ways (Rabitsch, 2008, Mutun et al. 2009). Since eggs and larvae hide in the foliage, and adults usually lurk in bark cracks, thus during forestation, it can be easily introduced even from distant sources (Küçükbasmaci, 2014). According

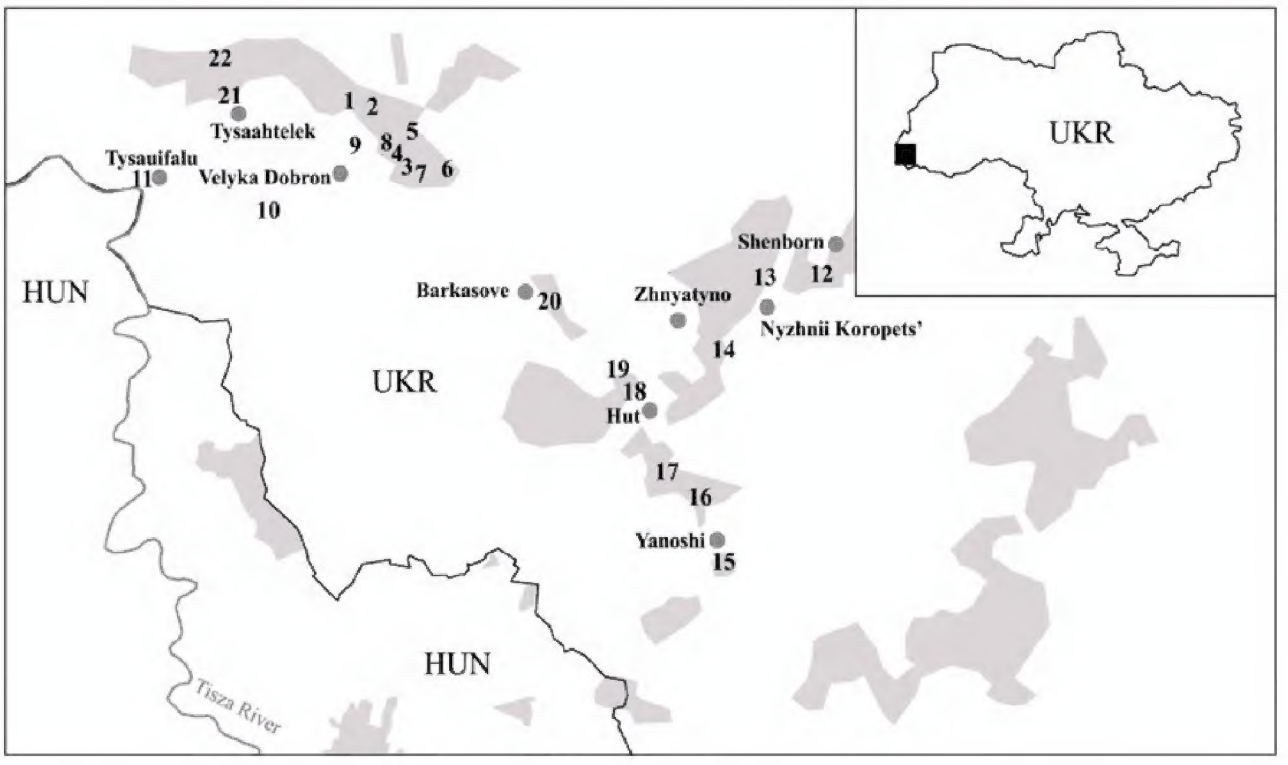

Figure 1. Sampling sites (1-22) of *Coryctucha arcuata* studied in 2020 in the remains of hardwood gallery and hornbeam-oak forests (grey polygons) of the Bereg Lowland (Northest Hungary and Transcarpathia, West Ukraine).

to the review of Csóka et al. (2020), the OLB attack Fagaceae trees, especially 48 different *Quercus* species. Their secondary occurrence can be observed on *Castanea* and *Fagus* species and some members of *Rosaceae* and *Betulaceae* plant families. In 2019 it was cause damage even on sweet chestnut in East Hungary (Kovács et al., 2020). In order to provide base for further actions and reliable tool for measuring the effect of OLB's damage Bălăcenoiu et al. (2021) carried out an online survey questionary in 9 central and sout European country.

Contrary to serious infestation and conspicuous damages caused by OLBs in the Carpathian Basin their occurrence and distribution in West Ukraine has not been studied and detected till now. The natural like remains of the formerly extended hardwood forests of the region serve potentially suitable habitats for them, that can endanger both their naturalness and forestry use. In 2020 we mapped distribution of OLB in the Ukrainian part of the Carpathian Lowland (West Ukraine) and study also the host plant preference to gather actual data and help further actions against this harmful pest species.

Materials and methods

Occurrence, abundance and host plant preference of *C. arcuata* were studied in 22 sampling sites in the Ukrainian part of the Carpathian Lowland in West Ukraine. Samplings were made between 22 June and 24 August 2020 mainly in the remains of hardwood gallery forests and hornbeam-oak forests of the Bereg Lowland. The dominant tree species of both forest type is *Q. robur*. In gallery forest *Ulmus minor*, *Acer campestre* and *A. tataricum*, while in hornbeam-oak forest *Carpinus betulus* are also characteristic. Beside these large and medium sized more or less isolated forest patches, we also studied some smaller and less suitable patches with such secondary hosts as *Acer campestre*, *Carpinus betulus* and *Ulmus minor*. The large remains of formerly continuous hardwood forests of the region are in connection with some large mainly similar Hungarian forests already infested by OLB (Table 1, Fig. 1). These forests preserve unique and species rich wildlife of former landscape, mainly destroyed during river regulation in the 18–19th century (Lehoczky, 1881; Baranyi, 2009).

Sampling was made with direct search of adults, damage and symptoms on the potential host plants of OLB. In each sampling sites 10 trees of each potential host plant were chosen, and 5 branches were investigated on each tree. The abundance of OLB was established based on a 3-category scale: 0: no infestation, 1: light infestation (mean number of individuals/leaf<5), 2: serious infestation (mean number of individual/leaf>5)

The observed specimens of OLB were identified according to Dobreva et al. (2013) and Golub, Soboleva (2018). The common lace bugs of the region (e.g. *C. ciliata*, *S. pyri*) and *C. arcuata* are similar in size (2.8 to 3.2 mm), hence the identification should be based on the pattern and morphology of wings and paranotum. Although pattern

Table 1. Location (GPS coordinates), species composition and value of infestation (*I*) of *Coryctucha arcuata* of the 22 sampling sites investigated in West Ukraine in 2020. *I*: 0 = no infestation; 1 = light infestation; 2 = serious infestation. ○: available but not occupied plants, ●: occupied non-host plant (OLB appear but did not feed on the plant), ●: occupied host plant (OLB feed and reproduce on the plant); !: formerly not mentioned host plant

Site	Coordinates		I.	Plant species														
	N	E		*Q. robur*	*Q. petraea*	*Q. rubra*	*Prunus avium*	*R. pseudoacacia*	*A. negundo*	*A. campestre*	*A. tataricum*	*F. excelsior*	*C. betulus*	*U. minor*	*C. avellana*	*P. tremula*	*S. caprea*	*T. platyphyllos*
1	48°26'59"	22°23'38"	2	●	○				○	○		○				○	○	
2	48°26'37"	22°24'30"	2	●					○			○			○	○	○	
3	48°25'15"	22°26'2"	1	●				○	○	○		○						
4	48°25'34"	22°25'39"	1	●					○	○	○				○			
5	48°25'44"	22°25'58"	1	●					○					○		○	○	
6	48°25'9"	22°27'30"	1	●					○	○						○	○	
7	48°25'3"	22°26'28"	1	●						○			○					
8	48°25'46"	22°25'8"	1	●						○			○		○			
9	48°25'35"	22°23'49"	1				●!											
10	48°24'23"	22°20'43"	0						○			○		○	○	○	○	
11	48°24'42"	22°16'3"	0						○	○						○	○	
12	48°22'31"	22°41'50"	1		●								○					
13	48°22'14"	22°39'44	1	●								○	○					
14	48°20'23"	22°38'9"	0			○				○			○	○			○	
15	48°14'57"	22°37'55"	1	●						○		○		○				
16	48°16'38"	22°37'10"	1	●									○		○		○	○
17	48°17'19"	22°35'54"	1	●									○					
18	48°19'19"	22°34'35"	1		●	●				○			○	○	○		○	
19	48°19'42"	22°34'3"	2		●			○	○				○		○		○	
20	48°21'31"	22°31'23"	1	●							○		○	○	○			
21	48°27'15"	22°19'15"	1	●				○	○	○				○	○	○	○	○
22	48°27'58"	22°18'46"	0						○	○						○	○	

of forewings of *C. arcuata* and *S. pyri* is similar, but their shape and the edge of the paranotum are different. Wings of *S. pyri* are rounded at the front and their paranotum has a smooth border. The wing of *C. arcuata* is angular at the front and there are elongated spines at the edge of its paranotum. Wings and paranotum of *C. arcuata* and *C. ciliata* are similar, but their colour are different (Fig. 2).

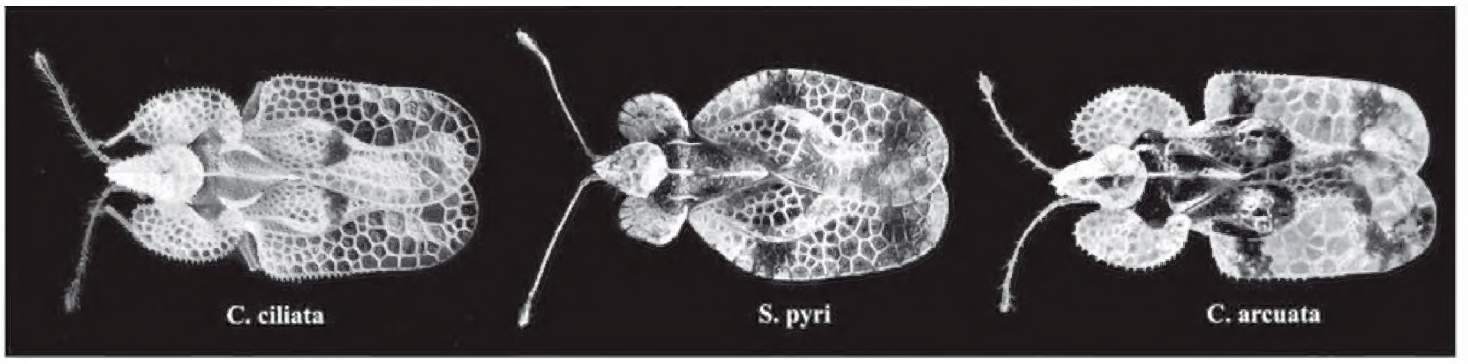

Figure 2 Morphology of *Corythucha ciliata* (source: https://www.invasive.org/browse/ detail.cfm?imgnum=5312017#) and *Stephanitis pyri* (source: http://www.agroatlas.ru/ en/content/pests/Stephanitis_pyri/index.html) common and abundant species of the studied region and the studied invasive *Corythucha arcuata* (source: https://alchetron.com/ Corythucha-arcuata).

Results and discussion

The occurrence of OLB was detected in 18 of the 22 sampling sites studied in 2020 in the Ukrainian part of the Carpathian Lowlands. The pest rapidly distributed and became common after it appeared in the neighbouring countries (Csóka et al., 2020), but it is still relatively less abundant in Transcarpathia region of West Ukraine. In 2020 infestation was high only in three infested sites (sites 1, 2, 19; Table 1.). The large forests of the region and medium sized forest patches in their surroundings (sites 15 and 20) were also but less infested. OLB was absent in the small, isolated patches where the main host oak species was not available (site 10 and 11). The OLB also appeared in a small village garden in Velyka Dobron' (site 9) (Fig. 1).

In the sampled sites totally 15 deciduous species occurred, and the mean species richness of these trees was 4.7 species per site. OLB preferred *Quercus* species, especially *Q. robur* if it was available, that confirm results of Csóka et al. (2020). In three sites, where was not *Q. robur*, *Q. petrea* and/or *Q. rubra* trees were occupied. In case of *Q. rubra* only the appearance of some adults could be detected, but this itself could not confirm that *Q. rubra* is a real host, as Trieff (2002), Bernardinelli (2006 a, b) and Csóka et al. (2020) formerly discussed. We found that *Q. petrea* was a suitable host, but it was only chosen when the more preferred *Q. robur* was not present even in case of high infestation (e.g., in site 1).

Amongst available non-oak trees of the sampling sites there were 4 known suitable host plants of OLB discussed by Csóka et al. (2020): *Acer campetre*, *Ulmus minor*, *Carpinus betulus* and *Tilia platyphyllos*. We could not record infestation on these non-oak hosts despite of presence of OLBs in the given sites. Beside them OLB was detected in a sweet cherry cultivar (site 9) which is the first record of the pest on a cultivated *Prunus* trees. Formerly Neimorovetz et al. (2017) mentioned wild cherry as a suitable host in Krasnodar Region (Crimean Peninsula). Other *Prunus spp.* (e.g. *P. serulata*, *P. lusitanica*, *P. serotine*, *P. spinosa* and *P. subhirtella*) and many other Rosaceae trees are also known hosts especially in Central–Europe (Hungary, Croatia and Serbia; Csóka

et al., 2020). The pest chose this unusual host probably since lack of the primary host. In this case *P. avium* became accepted host plant and could provide a suitable "steppingstone habitat" for further spread of the pest toward large forests. After successful colonisation and invasion of more suitable habitats they can choose amongst the more preferred host plants again.

With appearance and rapid spread of OLB in the Ukrainian part of the Carpathian Lowland open a new spreading rout into the inner part of the country. Although the Carpathians as nearly impassable barrier can retain the spread, but via transportation or accidental introduction the pest can pass it even in the near future. Parallelly with the effect of rapid climatic change (e.g. decreasing amount of precipitation and increasing number of heat days) the pest endangers the remains of natural hardwood and hornbeam-oak forests of the region. To protect these natural habitats and its unique wildlife (Magura et al., 1997; Szanyi, 2015; Szanyi et al., 2015) and slow down these harmful processes the pest should be monitored, and actions should be planned and carried out based on actual data.

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